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Kerner

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(54) **POWER SUPPLIES FOR LIGHTED SHELVES IN A REFRIGERATOR**

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F25D 27/00 (2006.01)
F25D 25/02 (2006.01)

(52) **U.S. Cl.**
CPC ***F25D 27/005*** (2013.01); ***F25D 25/024*** (2013.01)

(58) **Field of Classification Search**
CPC F25D 25/02; F25D 23/062
USPC 312/401, 408; 362/92, 94
See application file for complete search history.

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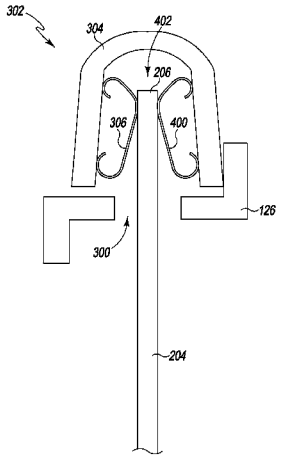
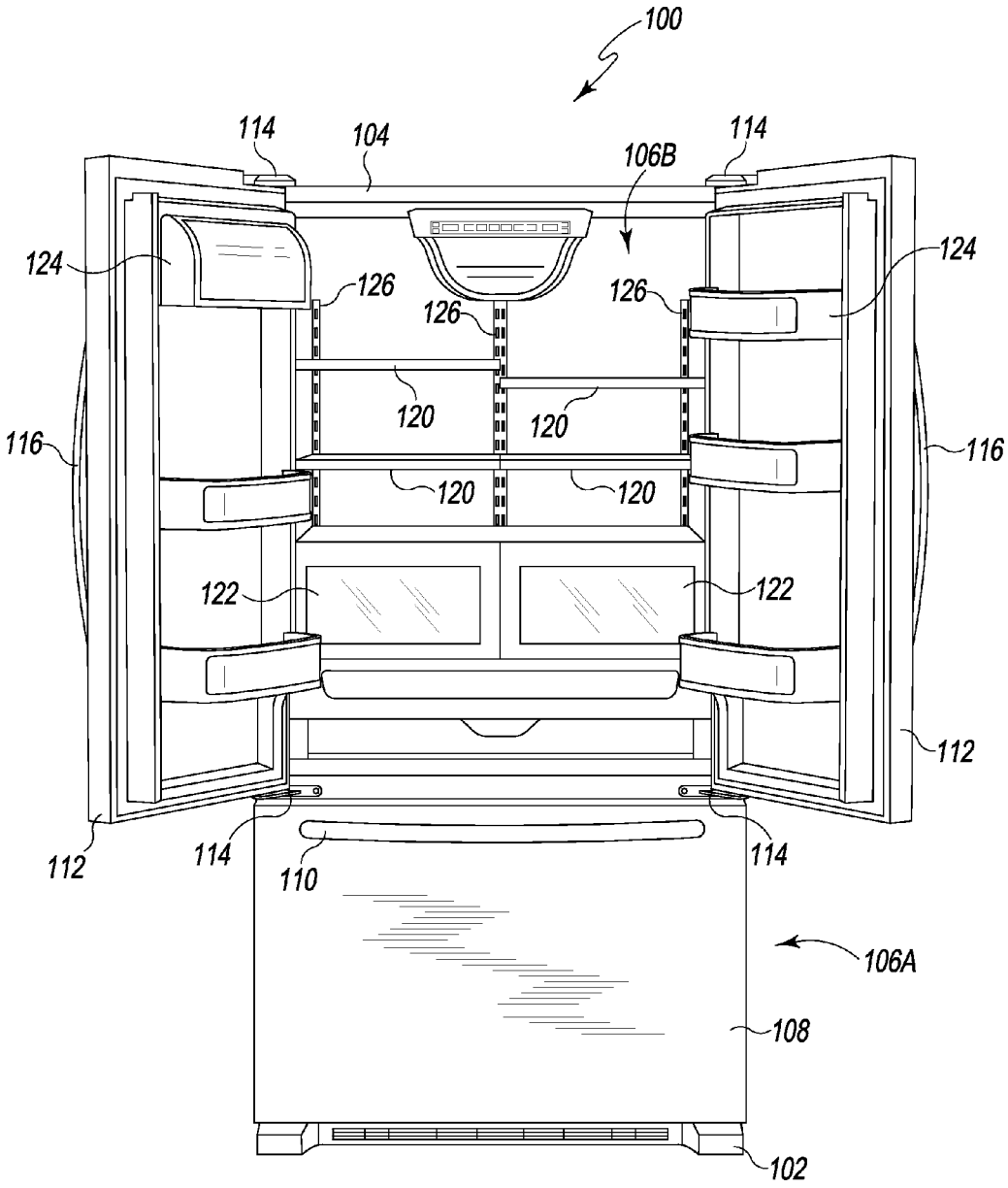
(57) **ABSTRACT**

Illustrative embodiments of systems and methods for powering lighted shelves in refrigerator appliances are included. In one embodiment, a refrigerator appliance may comprise a cabinet having a temperature-controlled compartment defined therein, a shelf ladder disposed at least partially in the temperature-controlled compartment and providing a plurality of shelf mounting positions, the shelf ladder comprising an electrical bus including first, second, and third conductors, the second conductor configured to supply power at a first current level when electrically coupled to the first conductor, the third conductor configured to supply power at a second current level when electrically coupled to the first conductor, and a first adjustable shelf carrying a first lighting device, the first adjustable shelf being removably mountable in one of the plurality of shelf mounting positions such that the first lighting device is electrically coupled between the first conductor and the second conductor.

20 Claims, 7 Drawing Sheets

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106A
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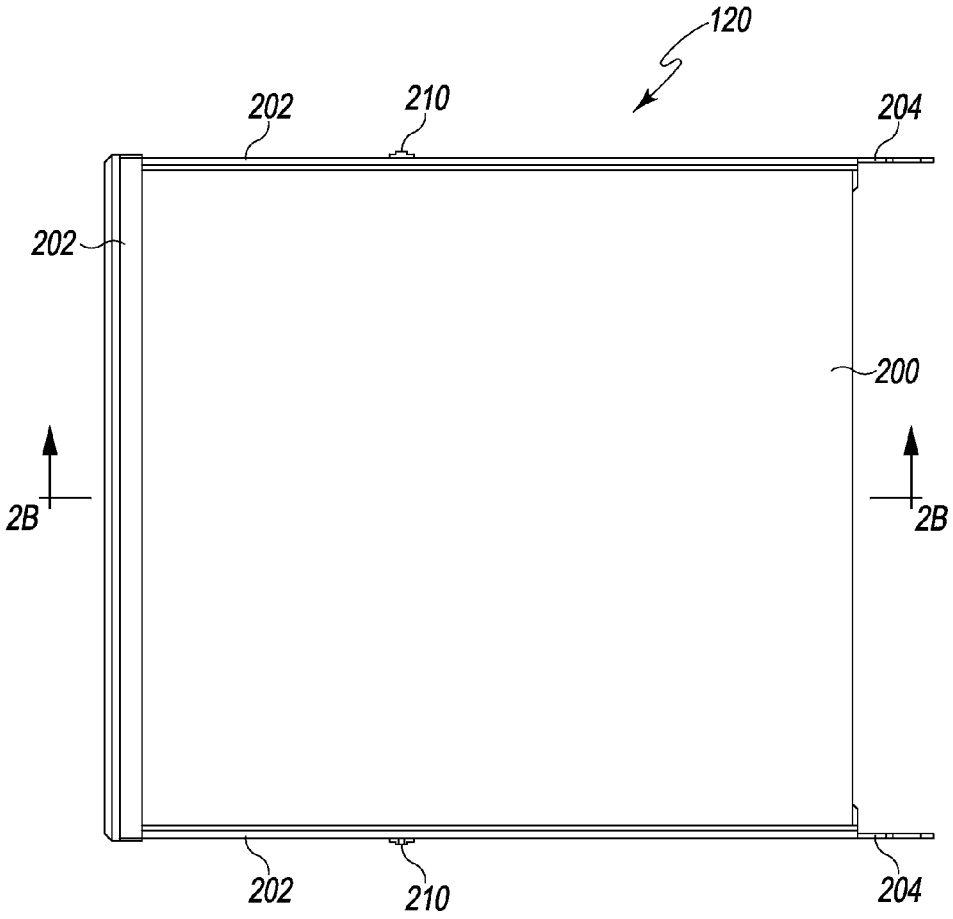
Fig. 1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2B
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Fig. 2A

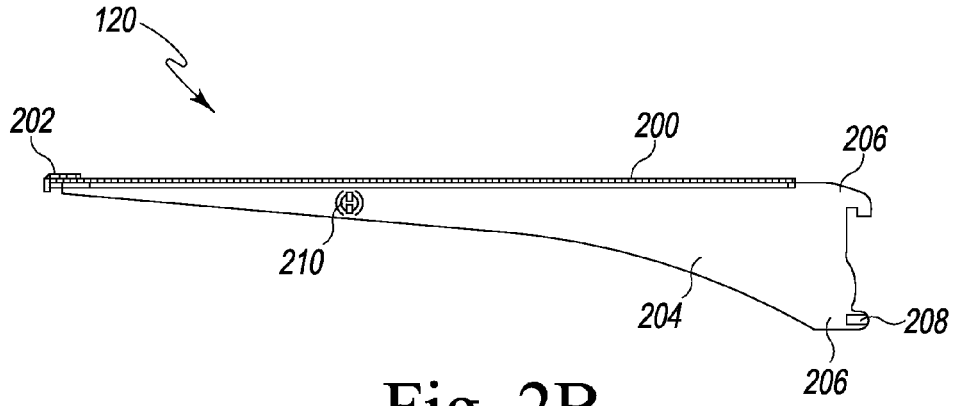
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Fig. 2B

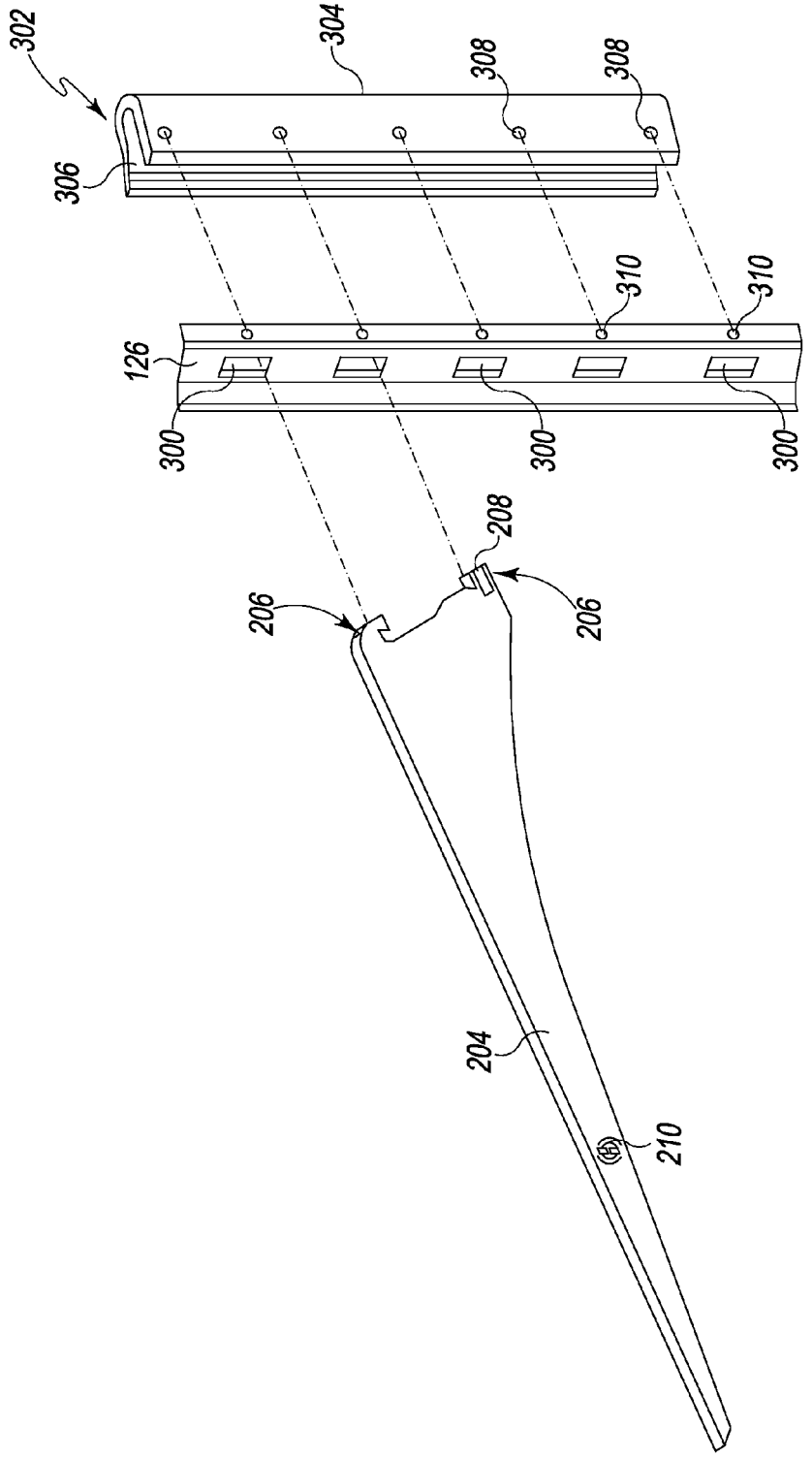

Fig. 3

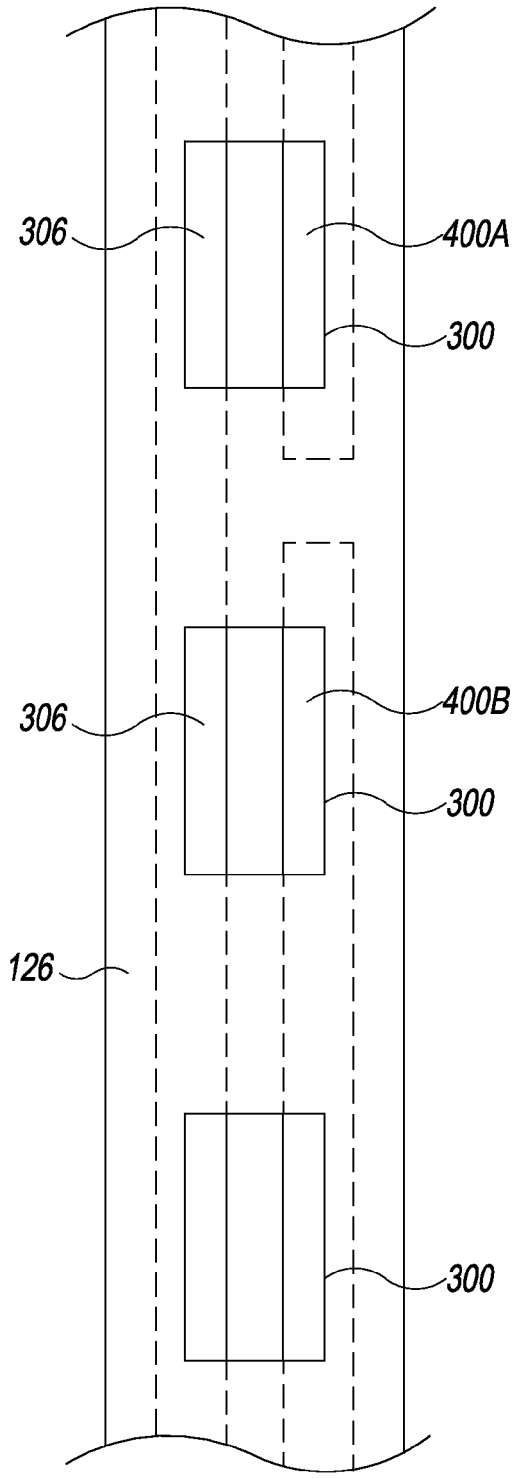

Fig. 4A

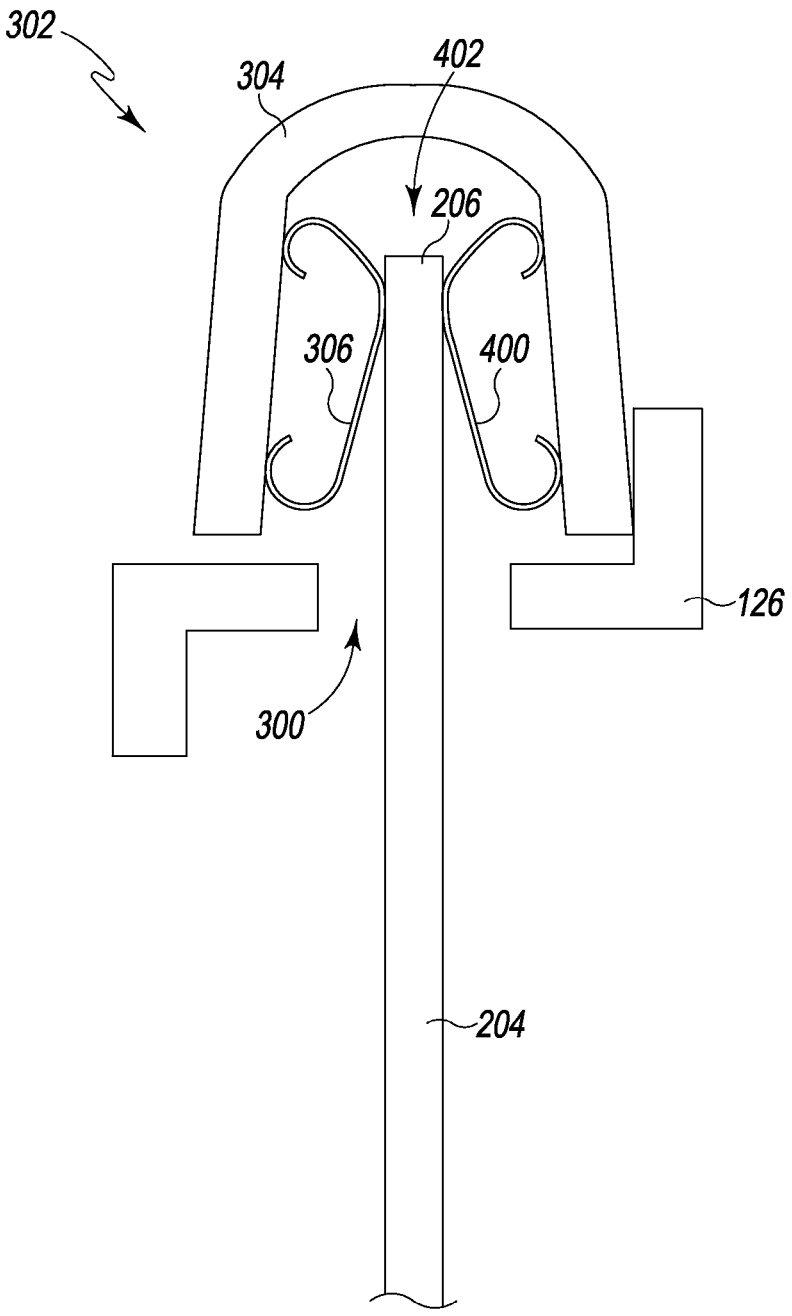

Fig. 4B

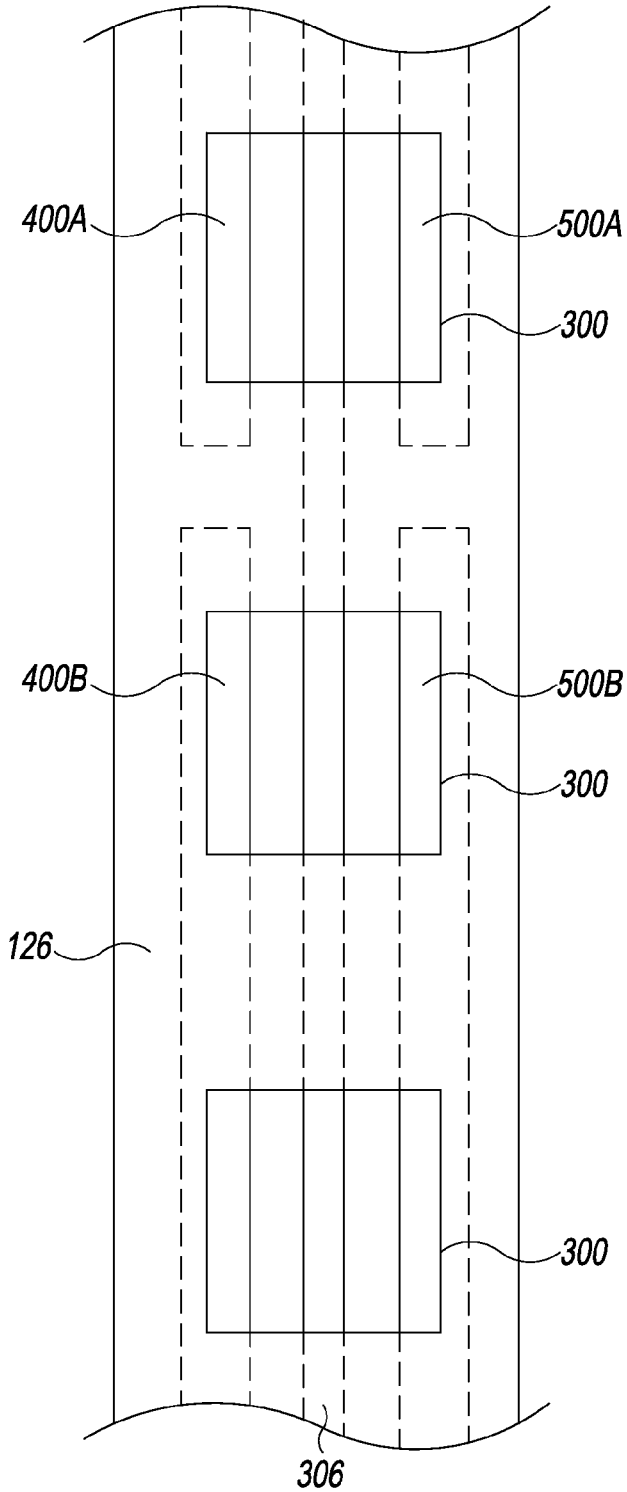

Fig. 5A

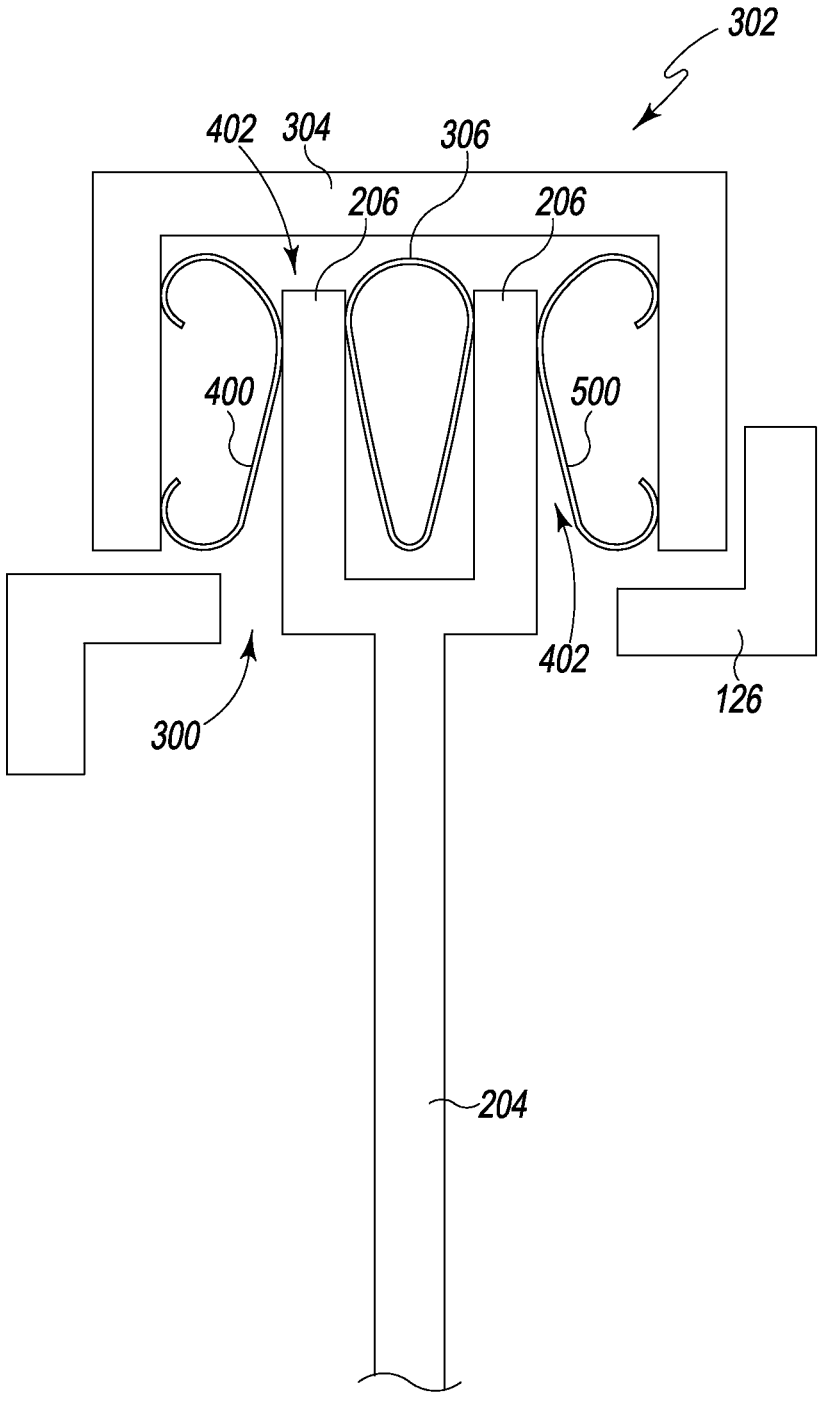

Fig. 5B

POWER SUPPLIES FOR LIGHTED SHELVES IN A REFRIGERATOR

TECHNICAL FIELD

The present disclosure relates, generally, to refrigerator appliances and, more particularly, to systems and methods for powering lighted shelves in refrigerator appliances.

BACKGROUND

A refrigerator is an appliance used to store food items at preset temperatures. A refrigerator appliance typically includes one or more temperature-controlled compartments into which food items may be placed to preserve the food items for later consumption. A refrigerator appliance also typically includes a plurality of shelves on which the food items may be arranged within the one or more temperature-controlled compartments. In some refrigerator appliances, the plurality of shelves may be adjustable (i.e., the shelves may each be removably mounted in a plurality of shelf mounting positions). Some or all of the plurality of shelves may also carry one or more lighting devices for illuminating food items placed in the one or more temperature-controlled compartments.

SUMMARY

According to one aspect, a refrigerator appliance may comprise a cabinet having a temperature-controlled compartment defined therein, a shelf ladder disposed at least partially in the temperature-controlled compartment and providing a plurality of shelf mounting positions, the shelf ladder comprising an electrical bus including first, second, and third conductors, the second conductor configured to supply power at a first current level when electrically coupled to the first conductor, the third conductor configured to supply power at a second current level when electrically coupled to the first conductor, and a first adjustable shelf carrying a first lighting device, the first adjustable shelf being removably mountable in one of the plurality of shelf mounting positions such that the first lighting device is electrically coupled between the first conductor and the second conductor.

In some embodiments, the refrigerator appliance may further comprise a second adjustable shelf carrying a second lighting device, the second adjustable shelf being removably mountable in one of the plurality of shelf mounting positions such that the second lighting device is electrically coupled between the first conductor and the third conductor. In other embodiments, the first adjustable shelf may further comprise a second lighting device, the second lighting device being electrically coupled between the first conductor and the third conductor when the first adjustable shelf is removably mounted in one of the plurality of shelf mounting positions. The first conductor may be positioned between the second and third conductors and may be spaced apart from both the second and third conductors. The first conductor may be electrically grounded.

In still other embodiments, the first adjustable shelf may comprise a mounting bracket configured to engage the shelf ladder to cantilever the first adjustable shelf in one of the plurality of shelf mounting positions. In such embodiments, the mounting bracket may comprise a first tab configured to electrically couple to the first conductor and to the second conductor when the first adjustable shelf is cantilevered in one of the plurality of shelf mounting positions. The mounting bracket may further comprise a second tab configured to electrically couple to the first conductor and to the third conductor when the first adjustable shelf is cantilevered in one of the plurality of shelf mounting positions. The first and second tabs of the mounting bracket may each be electrically isolated from a body of the mounting bracket that supports the first adjustable shelf.

In some embodiments, at least one of the first and second conductors may be spring-loaded to apply force against the first tab when the first adjustable shelf is cantilevered in one of the plurality of shelf mounting positions. In such embodiments, the first tab may be configured to scrape a portion of the first conductor and a portion of the second conductor as the first adjustable shelf is cantilevered in one of the plurality of shelf mounting positions.

According to another aspect, a refrigerator appliance may comprise a cabinet having a temperature-controlled compartment defined therein, a first shelf ladder disposed at least partially in the temperature-controlled compartment and including a first electrical bus configured to supply power at a first current level, a second shelf ladder disposed at least partially in the temperature-controlled compartment and including a second electrical bus configured to supply power at a second current level, and a first adjustable shelf carrying a first lighting device, the first adjustable shelf being removably mountable on the first and second shelf ladders such that the first lighting device is electrically coupled to the first electrical bus.

In some embodiments, the refrigerator appliance may further comprise a second adjustable shelf carrying a second lighting device, the second adjustable shelf being removably mountable on the first and second shelf ladders such that the second lighting device is electrically coupled to the second electrical bus. In other embodiments, the first adjustable shelf may further comprise a second lighting device, the second lighting device being electrically coupled to the second electrical bus when the first adjustable shelf is removably mounted in one of the plurality of shelf mounting positions.

In still other embodiments, the first adjustable shelf may comprise a first mounting bracket configured to engage the first shelf ladder and a second mounting bracket configured to engage the second shelf ladder to cantilever the first adjustable shelf on the first and second shelf ladders. In such embodiments, the first mounting bracket may comprise a first tab configured to electrically couple to the first electrical bus when the first adjustable shelf is cantilevered on the first and second shelf ladders. The second mounting bracket may comprise a second tab configured to electrically couple to the second electrical bus when the first adjustable shelf is cantilevered on the first and second shelf ladders. The first tab of the first mounting bracket may be electrically isolated from a body of the first mounting bracket that supports the first adjustable shelf.

In some embodiments, the first electrical bus may comprise first and second conductors having a gap therebetween, the gap between the first and second conductors being sized to receive the first tab when the first adjustable shelf is cantilevered on the first and second shelf ladders. At least one of the first and second conductors may be spring-loaded to apply force against the first tab when the first adjustable shelf is cantilevered on the first and second shelf ladders. In such embodiments, the first tab may be configured to scrape a portion of the first conductor and a portion of the second conductor as the first adjustable shelf is cantilevered on the first and second shelf ladders.

BRIEF DESCRIPTION OF THE DRAWINGS

The detailed description particularly refers to the following figures, in which:

FIG. **1** is a front elevation view of a refrigerator appliance showing a number of adjustable shelves removably mounted in a plurality of shelf mounting positions within a temperature-controlled compartment of the refrigerator appliance;

FIG. **2**A is top plan view of one embodiment of an adjustable shelf that is removably mountable in the refrigerator appliance of FIG. **1**;

FIG. **2**B is a cross-sectional view of the adjustable shelf of FIG. **2**A, taken along the line **2**B **2**B in FIG. **2**A;

FIG. **3** is a partially exploded view of one embodiment of a shelf ladder, an electrical bus, and a mounting bracket of the refrigerator appliance of FIG. **1**;

FIG. **4**A is a front elevation view of the shelf ladder and the electrical bus of FIG. **3**;

FIG. **4**B is a top cross-sectional view of one embodiment of a mounting bracket engaging the shelf ladder and the electrical bus of FIG. **4**A;

FIG. **5**A is a front elevation view of another embodiment of a shelf ladder and an electrical bus of the refrigerator appliance of FIG. **1**; and

FIG. **5**B is a top cross-sectional view of one embodiment of a mounting bracket engaging the shelf ladder and the electrical bus of FIG. **5**A.

Where considered appropriate, reference labels have been repeated among the figures to indicate corresponding or analogous elements.

DETAILED DESCRIPTION OF THE DRAWINGS

While the concepts of the present disclosure are susceptible to various modifications and alternative forms, specific exemplary embodiments thereof have been shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that there is no intent to limit the concepts of the present disclosure to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

Referring to FIG. **1**, a home appliance is shown as a refrigerator appliance **100** (hereinafter, the refrigerator **100**). One illustrative example of the refrigerator **100** is the Whirlpool Latitude French Door Refrigerator, which is commercially available from Whirlpool Corporation of Benton Harbor, Mich. The refrigerator **100** includes a lower frame **102** and a cabinet **104** extending upwardly from the lower frame **102**. The cabinet **104** of the refrigerator **100** includes a pair of temperature-controlled compartments **106** that are independently operable to maintain food items stored therein at one or more set temperatures.

The lower temperature-controlled compartment **106** is a freezer compartment **106**A, and the refrigerator **100** includes a drawer **108** that is positioned in the freezer compartment **106**A. The drawer **108** is moveable relative to the cabinet **104** such that food items may be placed in the drawer **108** for storage in the freezer compartment **106**A and retrieved from the drawer **108** when ready for use. A handle **110** is located on the drawer **108** so that a user may open and close the drawer **108**.

The upper temperature-controlled compartment **106** is a refrigerated compartment **106**B into which a user may place and store food items such as milk, cheese, produce, etcetera. A pair of doors **112** are each hinged to the front of the cabinet **104** via a pair of hinge assemblies **114**. The doors **112** permit user access to the refrigerated compartment **106**B such that food items may be placed in and retrieved from the refrigerated compartment **106**B. A handle **116** is located on each of the doors **112** so that a user may open and close the doors **112**.

While the illustrative embodiment of the refrigerator **100** shown in FIG. **1** is a "french-door" model with a pair of doors **112** operable to permit access to the refrigerated compartment **106**B, it should be appreciated that other configurations are contemplated, such as, for example, configurations having only one door **112** operable to permit access to the refrigerated compartment **106**B. Additionally, it should also be appreciated that, in some embodiments, the freezer compartment **106**A may be positioned above the refrigerated compartment **106**B and, in other embodiments, either one of the temperature-controlled compartments **106** may be omitted. It should be further appreciated that, in some embodiments, the refrigerator **100** may include more than one freezer compartment **106**A and/or more than one refrigerated compartment **106**B. Configurations of the refrigerator **100** are also contemplated in which the freezer compartment **106**A is located on one side of the cabinet **104** and the refrigerated compartment **106**B is located on the opposite side of the cabinet **104**.

As shown in FIG. **1**, the refrigerator **100** also includes four adjustable shelves **120** removably mounted within the refrigerated compartment **106**B, upon which a user of the refrigerator **100** may arrange food items. It is contemplated that the refrigerator **100** may include any number of adjustable shelves **120** within the temperature-controlled compartments **106**. As the adjustable shelves **120** are removably mounted within the refrigerated compartment **106**B, a user may remove any adjustable shelf **120** and relocate it to any available shelf mounting position within the refrigerated compartment **106**B. It will be appreciated that the refrigerator **100** may additionally or alternatively include other devices for supporting or storing food within the temperature-controlled compartments **106**, such as, for example, drawers **122** or door bins **124** (as shown in FIG. **1**). As used in the present disclosure, the term "shelf" is to be considered in its broadest sense as any device that will hold a food item, including shelves, drawers, bins, panels, racks, and the like.

The adjustable shelves **120** may be removably mounted within the refrigerated compartment **106**B using any suitable mechanism. In the illustrative embodiment of the refrigerator **100** shown in FIG. **1**, three shelf ladders **126** are disposed within the refrigerated compartment **106**B to provide a plurality of shelf mounting positions for the adjustable shelves **120**. It is contemplated that any number of shelf ladders **126** may be used for removably mounting the adjustable shelves **120**. In some embodiments, the shelf ladders **126** may be secured to one or more walls of the refrigerator compartment **106**B using screws, bolts, rivets, adhesive, or other fixation mechanisms. In other embodiments, the shelf ladders **126** may be integrally formed into one or more walls of the refrigerator compartment **106**B. It should also be appreciated that the adjustable shelves **120** may be removably mounted within the refrigerated compartment **106**B using any number of mechanisms other than the shelf ladders **126**. By way of example, the adjustable shelves **120** may be removably mounted within the refrigerated compartment **106**B using ledges, tracks, slides, glides, rollers, and the like.

One illustrative embodiment of an adjustable shelf **120** that is removably mountable within the refrigerated compartment **106**B is shown in FIGS. **2**A and **2**B. The adjustable shelf **120** includes a support surface **200** upon which a user of the refrigerator **100** may arrange food items. The support surface

200 may illustratively be formed of glass, plastic, or any other suitable material. As shown in FIGS. 2A and 2B, the support surface 200 is illustratively bounded on three sides by lips 202, which assist in retaining food items arranged on the support surface 200 of the adjustable shelf 120.

In the illustrative embodiment, the adjustable shelf 120 includes a pair of mounting brackets 204 that are spaced apart from one another the same distance as a pair of the shelf ladders 126 of the refrigerator 100. As described further below (with reference to FIG. 3), these mounting brackets 204 allow the adjustable shelf 120 to be removably mounted on a pair of the shelf ladders 126. As illustrated in FIG. 2B, each of the mounting brackets 204 of the adjustable shelf 120 may include a body and a number of tabs 206 configured to engage a number of slots of one of the shelf ladders 126. In some embodiments, the mounting bracket 204 may include multiple upper tabs 206 and/or multiple lower tabs 206 extending from the body of the mounting bracket 204. Any of the tabs 206 of the mounting bracket 204 may include a conductor 208 disposed on or integrated into the tab 206. Where one of the tabs 206 includes a conductor 208, the tab 206 may be electrically isolated from the body of the mounting bracket 204 (particularly, where the mounting bracket 204 is formed of a conductive material, such as steel).

Some or all of the adjustable shelves 120 may carry one or more lighting devices 210 for illuminating food items placed in the refrigerated compartment 106B. For instance, each of the adjustable shelves 120 may carry one or more light emitting diodes (LEDs) 210. It is contemplated that, in some embodiments, some of the adjustable shelves 120 of the refrigerator 100 may not carry a lighting device (i.e., the refrigerator 100 may include both lighted and non-lighted adjustable shelves 120). Each lighting device 210 carried by an adjustable shelf 120 may be electrically coupled to a conductor 208 disposed on or integrated into one of the tabs 206 of a mounting bracket 204 of the adjustable shelf 120. As described further below, the conductor 208 may be electrically coupled to an electrical bus in one of the shelf ladders 126 when the adjustable shelf is removably mounted in the refrigerated compartment 106B. As such, the corresponding lighting device 210 will also be electrically coupled to the electrical bus in the shelf ladder 126 when the adjustable shelf is removably mounted in the refrigerated compartment 106B.

As shown in more detail in FIG. 3, each of the shelf ladders 126 in the illustrative embodiment of refrigerator 100 has a number of slots 300 defined therein. As described above, each of the adjustable shelves 120 may illustratively include a pair of mounting brackets 204 that are spaced apart from one another the same distance as a pair of the shelf ladders 126 (one such mounting bracket 204 being shown in FIG. 3). The mounting brackets 204 of an adjustable shelf 120 may each engage one or more slots 300 defined in one of the shelf ladders 126 to cantilever the adjustable shelf 120 to a pair of shelf ladders 126. As such, the slots 300 defined in the shelf ladders 126 provide a plurality of shelf mounting positions for the adjustable shelves 120. In the illustrative embodiment, the slots 300 defined in the shelf ladders 126 (and, hence, the shelf mounting positions) are spaced approximately one inch apart. It will be appreciated that other configurations for the spacing of the slots 300 and the shelf mounting positions are possible.

In the illustrative embodiment of the refrigerator 100, one or more of the shelf ladders 126 may include an electrical bus 302 positioned within (or behind) each slot 300 defined in the shelf ladder(s) 126, as illustrated in FIG. 3. It will be appreciated that, where each adjustable shelf 120 engages two or more shelf ladders 126, only some of the shelf ladders 126 may include an electrical bus 302. The electrical bus 302 includes an insulating housing 304 that supports at least one electrical conductor 306. In some embodiments, the insulating housing 304 may include a number of protrusions 308 that snap into corresponding holes 310 on the shelf ladder 126 to secure the electrical bus 302 behind the shelf ladder 126. In other embodiments, an electrical bus 302 may be secured to one of the shelf ladders 126 using screws, bolts, rivets, adhesive, or other fixation mechanisms.

As described above (with reference to FIG. 2B), a mounting bracket 204 of an adjustable shelf 120 may include a number of tabs 206 configured to engage a number of slots 300 of one of the shelf ladders 126. In the illustrative embodiment of FIG. 3, an upper tab 206 may have a hook shape that rests on a lower edge of one of the slots 300 when the adjustable shelf 120 is removably mounted in one of the shelf mounting positions. The mounting bracket 204 may also have a lower tab 206 that extends through an adjacent slot 300 of the shelf ladder 126. As noted above, the mounting bracket 204 may include multiple upper tabs 206 and/or multiple lower tabs 206 extending from the body of the mounting bracket 204, any of which may include one or more conductors 208. When one of the tabs 206 extends through a slot 300 defined in the shelf ladder 126 (when the adjustable shelf 120 is removably mounted in one of the shelf mounting positions), a conductor 208 carried by the tab 206 may contact the at least one conductor 306 of the electrical bus 302 behind the slot 300 to provide power to any lighting devices 210 carried by the adjustable shelf 120. It is contemplated that each mounting bracket 204 (and each tab 206 thereof) may carry any number of conductors 208 for interfacing with any number of conductors 306 included in the electrical bus 302.

As shown in the illustrative embodiment of FIGS. 4A and 4B, the electrical bus 302 may include two conductors 306, 400 supported behind the shelf ladder 126. Both of the conductors 306, 400 are accessible through one or more of the slots 300 of the shelf ladder 126, but are otherwise shielded by a face of the shelf ladder 126. As illustrated by the conductor 306 in FIG. 4A, some or all of the conductors of the electrical bus 302 may be continuous and may be exposed in each slot 300 of the shelf ladder 126. Additionally or alternatively, as illustrated by the conductor 400 in FIG. 4A, some or all of the conductors of the electrical bus 302 may be separated into discrete sections 400A, 400B that are each exposed in only some slots 300 of the shelf ladder 126. These discrete sections 400A, 400B of the conductor 400 may each form independent electrical circuits with the continuous conductor 306. In the illustrative embodiment of FIGS. 4A and 4B, the continuous conductor 306 is electrically grounded.

The engagement of a mounting bracket 204 of an adjustable shelf 120 with the shelf ladder 126 and the electrical bus 302 of FIG. 4A is illustratively shown in cross-section in FIG. 4B. The conductors 306, 400 of the electrical bus 302 are each disposed on one side of the housing 304 and are spaced apart by a gap 402. The gap 402 may be sized to prevent degenerate growth between the conductors 306, 400. One or both of the conductors 306, 400 may be spring-loaded to narrow (but not close) the gap 402 between the conductors 306, 400. In the illustrative embodiment of FIG. 4B, the conductors 306, 400 are each comprised of a deformable metal that may be bent out of shape by sufficient force, but that returns to its original shape in the absence of such force. It is also contemplated that, in other embodiments, the conductors 306, 400 may be spring-loaded by other mechanisms (e.g., non-deformable conductors 306, 400 that are coupled to the housing 304 by traditional springs).

Where the conductors **306**, **400** are spring-loaded, the conductors **306**, **400** will apply force against a tab **206** of the mounting bracket **204** that is received in the slot **300** of the shelf ladder **126**. This force between the conductors **306**, **400** and the tab **206** may help to ensure a good electrical connection between the conductors **306**, **400** and a conductor **208** carried by the tab **206**. Furthermore, where the conductors **306**, **400** are spring-loaded, the tab **206** may scrape portions of the conductors **306**, **400** as the tab **206** enters the electrical bus **302** and pushes against the conductors **306**, **400**. This scraping may remove surface grime from the conductors **306**, **400** and further help to ensure a good electrical connection between the conductors **306**, **400** and a conductor **208** carried by the tab **206**.

As described above, in one illustrative embodiment of the refrigerator **100**, each adjustable shelf **120** includes two mounting brackets **204** that each engage one of the shelf ladders **126**. In embodiments where each shelf ladder **126** includes an associated electrical bus **302**, one or more lighting devices **210** carried by each adjustable shelf **120** may electrically couple to one or both electrical buses **302**. The lighting devices **210** may electrically couple to the electrical buses **302** via one or more conductors **208** carried by one or more tabs **206** of one or both mounting brackets **204**. For instance, one adjustable shelf **120** may electrically couple its lighting device **210** to the electrical bus **302** of a first shelf ladder **126**, while another adjustable shelf **120** may electrically couple its lighting device **210** to the electrical bus **302** of a second shelf ladder **126** (both adjustable shelves **120** being cantilevered on the first and second shelf ladders **126**). Additionally or alternatively, an adjustable shelf **120** may electrically couple a first lighting device **210** to the electrical bus **302** of a first shelf ladder **126**, while electrically coupling a second lighting device **210** carried by the same adjustable shelf **120** to the electrical bus **302** of a second shelf ladder **126**.

Where each adjustable shelf **120** is removably mountable on two shelf ladders **126**, each including a corresponding electrical bus **302**, these two electrical buses **302** may supply power at different current levels. For instance, one electrical bus may supply power at a current level of 100 milliamps, while the other electrical bus **302** supplies power at a lower current level, such as, for example, 30 or 50 milliamps. Where two electrical buses **302** are available to supply power to each adjustable shelf **120** at different current levels (e.g., 30, 50, or 100 milliamps), the adjustable shelves **120** may carry different types of LEDs **210**. For instance, some adjustable shelves **120** may carry white LEDs **210**, other adjustable shelves **120** may carry color LEDs **210**, and still other adjustable shelves **120** may carry both white and color LEDs **210**. Each adjustable shelf **120** may then electrically couple each of the LEDs **210** to the appropriate electrical bus **302** to receive power at the appropriate current level for that LED **210**.

As shown in FIGS. **5**A and **5**B, another illustrative embodiment of the electrical bus **302** may include three conductors **306**, **400**, **500** supported behind the shelf ladder **126**. Each of the conductors **306**, **400**, **500** is accessible through one or more of the slots **300** of the shelf ladder **126**, but is otherwise shielded by a face of the shelf ladder **126**. As illustrated by the conductor **306** in FIG. **5**A, some or all of the conductors of the electrical bus **302** may be continuous and may be exposed in each slot **300** of the shelf ladder **126**. Additionally or alternatively, as illustrated by the conductors **400**, **500** in FIG. **5**A, some or all of the conductors of the electrical bus **302** may be separated into discrete sections **400**A, **400**B, **500**A, **500**B that are each exposed in only some slots **300** of the shelf ladder **126**. These discrete sections **400**A, **400**B, **500**A, **500**B of the conductors **400**, **500** may each form independent electrical circuits with the continuous conductor **306**. In the illustrative embodiment of FIGS. **5**A and **5**B, the continuous conductor **306** is electrically grounded.

The engagement of a mounting bracket **204** of an adjustable shelf **120** with the shelf ladder **126** and the electrical bus **302** of FIG. **5**A is illustratively shown in cross-section in FIG. **5**B. The conductors **400**, **500** of the electrical bus **302** are each disposed on one side of the housing **304**. The conductor **306** is disposed between the conductors **400**, **500** and is spaced apart from each conductor **400**, **500** by a respective gap **402**. The respective gaps **402** may be sized to prevent degenerate growth between the conductors **306**, **400**, **500**. One or more of the conductors **306**, **400**, **500** may be spring-loaded to narrow (but not close) the gaps **402** between the conductors **306**, **400**, **500**. In the illustrative embodiment of FIG. **5**B, the conductors **306**, **400**, **500** are each comprised of a deformable metal that may be bent out of shape by sufficient force, but that returns to its original shape in the absence of such force. It is also contemplated that, in other embodiments, the conductors **306**, **400**, **500** may be spring-loaded by other mechanisms (e.g., non-deformable conductors **400**, **500** that are coupled to the housing **304** by traditional springs).

Where the conductors **306**, **400**, **500** are spring-loaded, the conductors **306**, **400**, **500** will apply force against the tabs **206** of the mounting bracket **204** that are received in the slot **300** of the shelf ladder **126**. This force between the conductors **306**, **400**, **500** and the tabs **206** may help to ensure a good electrical connection between the conductors **306**, **400**, **500** and one or more conductors **208** carried by the tabs **206**. Furthermore, where the conductors **306**, **400**, **500** are spring-loaded, the tabs **206** may scrape portions of the conductors **306**, **400**, **500** as the tabs **206** enter the electrical bus **302** and push against the conductors **306**, **400**, **500**. This scraping may remove surface grime from the conductors **306**, **400**, **500** and further help to ensure a good electrical connection between the conductors **306**, **400**, **500** and one or more conductors **208** carried by the tabs **206**.

In an illustrative embodiment of the refrigerator **100** employing the shelf ladder **126** and electrical bus **302** of FIGS. **5**A and **5**B, one or more lighting devices **210** carried by each adjustable shelf **120** may electrically couple to either the conductors **306**, **400** or the conductors **306**, **500**. The lighting devices **210** may electrically couple to either pair of conductors of the electrical bus **302** via one or more conductors **208** carried by one or more tabs **206** of a mounting bracket **204** of the adjustable shelf **120**. For instance, one adjustable shelf **120** may electrically couple its lighting device **210** to the conductors **306**, **400** of the electrical bus **302**, while another adjustable shelf **120** may electrically couple its lighting device **210** to the conductors **306**, **500** of the electrical bus **302**. Additionally or alternatively, an adjustable shelf **120** may electrically couple a first lighting device **210** to the conductors **306**, **400** of the electrical bus **302**, while electrically coupling a second lighting device **210** carried by the same adjustable shelf **120** to the conductors **306**, **500** of the electrical bus **302**.

In embodiments employing the electrical bus **302** of FIGS. **5**A and **5**B, the conductors **400**, **500** may supply power at different current levels when electrically coupled to the conductor **306**. For instance, the conductor **400** may supply power at a current level of 100 milliamps, while the conductor **500** may supply power at a lower current level, such as, for example, 30 or 50 milliamps. Where different pairs of the conductors **306**, **400**, **500** are available to supply power to each adjustable shelf **120** at different current levels (e.g., 30, 50, or 100 milliamps), the adjustable shelves **120** may carry different types of LEDs **210**. For instance, some adjustable

shelves **120** may carry white LEDs **210**, other adjustable shelves **120** may carry color LEDs **210**, and still other adjustable shelves **120** may carry both white and color LEDs **210**. Each adjustable shelf **120** may then electrically couple each of the LEDs **210** to the appropriate pair of the conductors **306**, **400**, **500** of the electrical bus **302** to receive power at the appropriate current level for that LED **210**.

There are a plurality of advantages of the present disclosure arising from the various features of the systems, apparatus, and methods described herein. It will be noted that alternative embodiments of the systems, apparatus, and methods of the present disclosure may not include all of the features described yet still benefit from at least some of the advantages of such features. Those of ordinary skill in the art may readily devise their own implementations of the systems, apparatus, and methods that incorporate one or more of the features of the present disclosure and fall within the spirit and scope of the present invention as defined by the appended claims.

The invention claimed is:

1. A refrigerator appliance comprising:

a cabinet having a temperature-controlled compartment defined therein;

a shelf ladder disposed at least partially in the temperature-controlled compartment and providing a plurality of shelf mounting positions, the shelf ladder comprising an electrical bus including first, second, and third bus conductors, the second bus conductor connected to a first circuit that supplies power at a first current level when electrically coupled to the first bus conductor, the third bus conductor connected to a second circuit that supplies power at a second current level when electrically coupled to the first bus conductor; and

a first adjustable shelf carrying a first lighting device, the first adjustable shelf being removably mountable in one of the plurality of shelf mounting positions such that the first lighting device is electrically coupled between the first bus conductor and the second bus conductor.

2. The refrigerator appliance of claim **1**, further comprising a second adjustable shelf carrying a second lighting device, the second adjustable shelf being removably mountable in one of the plurality of shelf mounting positions such that the second lighting device is electrically coupled between the first bus conductor and the third bus conductor.

3. The refrigerator appliance of claim **1**, wherein the first adjustable shelf further comprises a second lighting device, the second lighting device being electrically coupled between the first bus conductor and the third bus conductor when the first adjustable shelf is removably mounted in one of the plurality of shelf mounting positions.

4. The refrigerator appliance of claim **1**, wherein the first bus conductor is positioned between the second and third bus conductors and is spaced apart from both the second and third bus conductors.

5. The refrigerator appliance of claim **4**, wherein the first bus conductor is electrically grounded.

6. The refrigerator appliance of claim **1**, wherein the first adjustable shelf comprises a mounting bracket configured to engage the shelf ladder to cantilever the first adjustable shelf in one of the plurality of shelf mounting positions, the mounting bracket comprising a first tab configured with tab electrical conductors in electrical communication with the first lighting device to electrically couple to the first bus conductor and to the second bus conductor when the first adjustable shelf is cantilevered in one of the plurality of shelf mounting positions.

7. The refrigerator appliance of claim **6**, wherein the mounting bracket further comprises a second tab configured with tab electrical conductors to electrically couple to the first bus conductor and to the third bus conductor when the first adjustable shelf is cantilevered in one of the plurality of shelf mounting positions.

8. The refrigerator appliance of claim **7**, wherein the tab electrical conductors of the first and second tabs of the mounting bracket are each electrically isolated from a body of the mounting bracket that supports the first adjustable shelf.

9. The refrigerator appliance of claim **6**, wherein at least one of the first and second bus conductors is spring-loaded to apply force against a tab conductor of the first tab when the first adjustable shelf is cantilevered in one of the plurality of shelf mounting positions.

10. The refrigerator appliance of claim **9**, wherein tab conductors of the first tab is configured to scrape a portion of the first bus conductor and a portion of the second bus conductor as the first adjustable shelf is cantilevered in one of the plurality of shelf mounting positions.

11. A refrigerator appliance comprising:

a cabinet having a temperature-controlled compartment defined therein;

a first shelf ladder disposed at least partially in the temperature-controlled compartment and including a first electrical bus connected to a first circuit that supplies power at a first current level;

a second shelf ladder disposed at least partially in the temperature-controlled compartment and including a second electrical bus connected to a second circuit that supplies power at a second current level; and

a first adjustable shelf carrying a first lighting device, the first adjustable shelf being removably mountable on the first and second shelf ladders such that the first lighting device is electrically coupled to the first electrical bus.

12. The refrigerator appliance of claim **11**, further comprising a second adjustable shelf carrying a second lighting device, the second adjustable shelf being removably mountable on the first and second shelf ladders such that the second lighting device is electrically coupled to the second electrical bus.

13. The refrigerator appliance of claim **11**, wherein the first adjustable shelf further comprises a second lighting device, the second lighting device being electrically coupled to the second electrical bus when the first adjustable shelf is removably mounted in one of the plurality of shelf mounting positions.

14. The refrigerator appliance of claim **11**, wherein the first adjustable shelf comprises a first mounting bracket configured to engage the first shelf ladder and a second mounting bracket configured to engage the second shelf ladder to cantilever the first adjustable shelf on the first and second shelf ladders.

15. The refrigerator appliance of claim **14**, wherein the first mounting bracket comprises a first tab configured to electrically couple to the first electrical bus when the first adjustable shelf is cantilevered on the first and second shelf ladders.

16. The refrigerator appliance of claim **15**, wherein the second mounting bracket comprises a second tab configured to electrically couple to the second electrical bus when the first adjustable shelf is cantilevered on the first and second shelf ladders.

17. The refrigerator appliance of claim **15**, wherein the first tab of the first mounting bracket is electrically isolated from a body of the first mounting bracket that supports the first adjustable shelf.

18. The refrigerator appliance of claim **15**, wherein the first electrical bus comprises first and second conductors having a gap therebetween, the gap between the first and second con-

ductors being sized to receive the first tab when the first adjustable shelf is cantilevered on the first and second shelf ladders.

19. The refrigerator appliance of claim **18**, wherein at least one of the first and second conductors is spring-loaded to apply force against the first tab when the first adjustable shelf is cantilevered on the first and second shelf ladders.

20. The refrigerator appliance of claim **19**, wherein the first tab is configured to scrape a portion of the first conductor and a portion of the second conductor as the first adjustable shelf is cantilevered on the first and second shelf ladders.

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